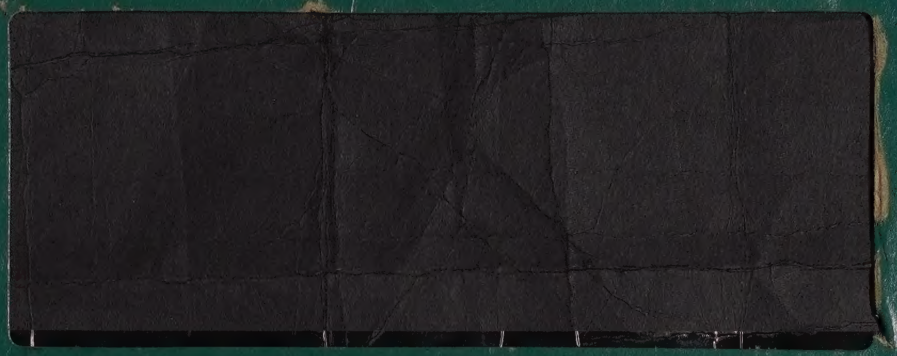
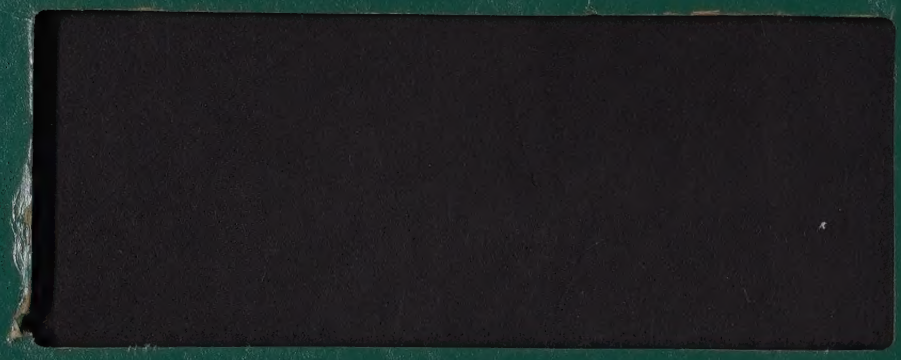


BOONTON ELECTRONICS CORPORATION



Serial Number: 6051

Instruction Book
MODEL 91CA
RF Voltmeter

Do not use for serial numbers below 5441.

BOONTON ELECTRONICS CORPORATION

ROUTE 287 AT SMITH ROAD
PARSIPPANY, N. J.– 07054

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SECTION I

MODEL 91 CA

SPECIFICATIONS

1.1	Measurement Range:		300 microvolts to 3 volts
1.2	Full Scale Ranges:		.001, .003, .01, .03, .1, .3, 1, 3 volts.
1.3	Frequency Range:		20 Kc to 1200 Mc*
1.4	Accuracy:	.003 range and above	5% of full scale to 400 Mc 10% of full scale above 400 Mc
		.001 range only	10% of full scale to 400 Mc 15% of full scale above 400 Mc
1.5	Input Impedance:		91-12E RF Probe See curve for shunt resistance data on high impedance probe. Shunt capacitance varies inversely with input voltage from 1.5 to 3pf. 91-8B 50Ω BNC Adapter Max. VSWR 1.2 up to 600 MC. 91-13A Probe Tip For direct measurements up to 250 MC.
1.6	Tube Complement:		1 each: BEC 525001, 7199, 6AU6, OA2, and 6X4.
1.7	Power Requirements:		105-125 volts, 58-62 ∿ 30 watts.
1.8	Dimensions		7-1/9 W, x 9-1/2 D, x 11 H excluding handle
1.9	Weight		12 pounds

*For measurements in this region use of the 91-14 "Tee" Adapter and 91-15A 50Ω Termination is strongly recommended. See page 2a.

SECTION II

GENERAL DESCRIPTION

The 91CA RF Voltmeter is a sensitive instrument for the measurement of voltages of 300 microvolts to 3 volts spanning a wide frequency range of 20 kilocycles to 1200 megacycles. In addition to conveniently measuring voltage levels in a diversity of rf circuits, the instrument has application for many associated tests. Such measurements include: the frequency response of both active and passive networks, i.e., amplifiers and filters; VSWR and return loss on transmission lines and attendant systems; attenuation and insertion loss of r-f attenuators; and high frequency parameters of transistors. With true rms response below 0.03 volt (up to 3 volts with the 91-7C 100:1 divider), wide band noise can be measured, and using suitable null networks measurement of the harmonic distortion of RF waveforms can be performed without the attendant errors of average type meters.

The instrument is also useful as an r-f null detector for bridge measurements and analogous techniques when a sensitivity in the order of 200 microvolts will suffice.

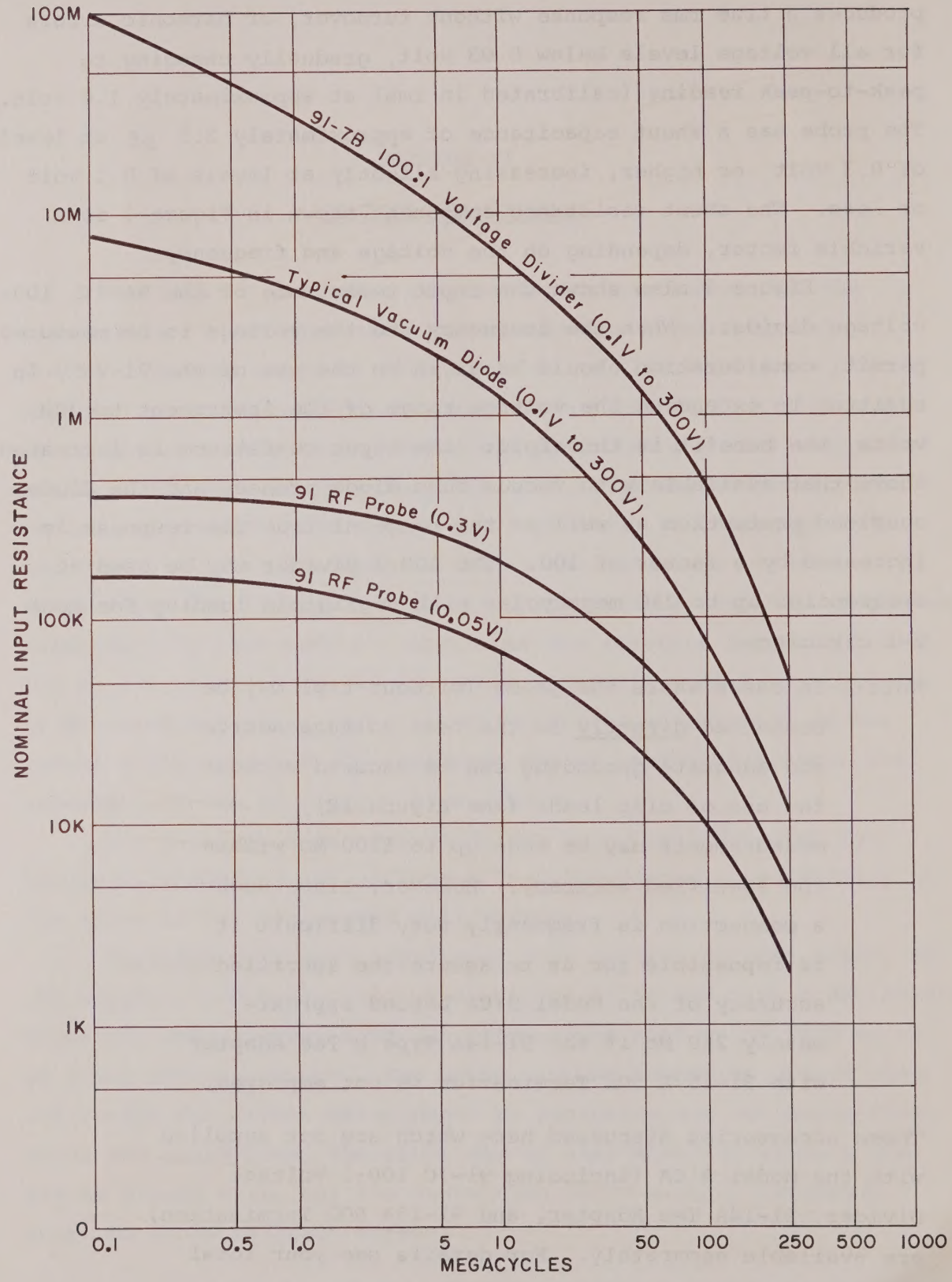
Supplied with each instrument is a general purpose probe, 50 ohm adapter, and probe tip. The adapter is fitted with a BNC coaxial connector and provides a 50 ohm termination with a low VSWR up to at least 600 megacycles. The probe tip and companion ground clip are useful for direct measurement to approximately 100 megacycles. Above 100 megacycles, the probe may be used directly without the tip or ground clip, but the connecting leads must be extremely short to avoid resonant effects.

The 91-12E probe with its full-wave crystal detecting circuit produces a true rms response without turnover, or harmonic errors for all voltage levels below 0.03 volt, gradually changing to peak-to-peak reading (calibrated in rms) at approximately 1.0 volt. The probe has a shunt capacitance of approximately 2.5 pf at levels of 0.3 volt or higher, increasing slightly at levels of 0.1 volt or less. The shunt resistance component shown in Figure 1 is a variable factor, depending on the voltage and frequency.

Figure 1 also shows the input resistance of the 91-7C 100:1 voltage divider. When the frequency and the voltage to be measured permit, consideration should be given to the use of the 91-7C In addition to extending the voltage range of the instrument to 300 volts, the benefit is threefold: the input resistance is increased above that available with vacuum tube diode probes, and the diode overload protection as well as the range of true rms response is increased by a factor of 100. The 100:1 divider may be used at frequencies up to 250 megacycles with negligible loading for most r-f circuitry.

Note: In cases where the probe (without tip) may be connected directly to the test voltage source and adequate grounding can be secured without the use of clip leads (see Figure 1E), measurements may be made up to 1200 Mc within the specified accuracy. However, since such a connection is frequently very difficult it is impossible for us to assure the specified accuracy of the Model 91CA beyond approximately 250 Mc if the 91-14A Type N Tee Adapter with 91-15 A 50Ω Termination is not employed.

Those accessories discussed here which are not supplied with the Model 91CA (including 91-7C 100:1 Voltage Divider, 91-14A Tee Adapter, and 91-15A 50Ω Termination) are available separately. For details see your local Boonton Electronics Sales Engineering Representative.


100M
10M
1M
100K
10K
1K
0
NOMINAL INPUT RESISTANCE
91-7B 100:1 Voltage Divider (0.1V to 300V)
Typical Vacuum Diode (0.1V to 300V)
91 RF Probe (0.3V)
91 RF Probe (0.05V)
0.1
0.5
1.0
5
10
50
100
250
500
1000
MEGACYCLES

91CA
c

Fig 1a

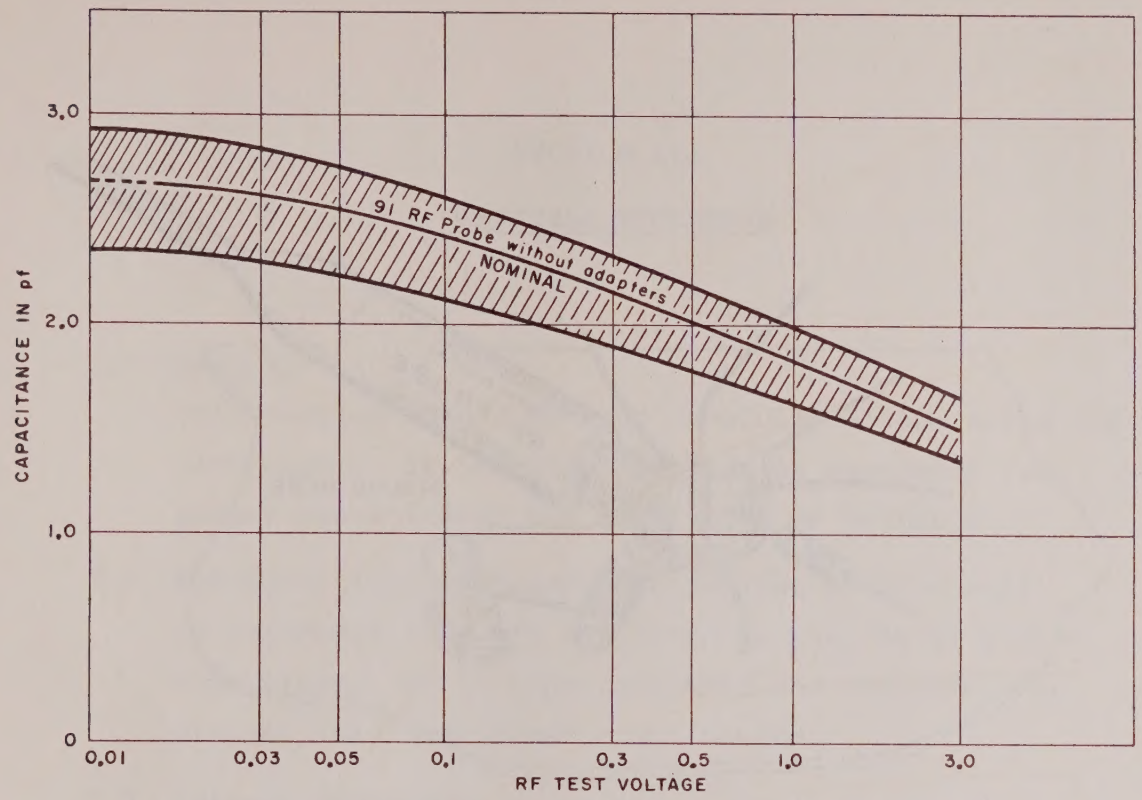


FIGURE 1B. INPUT CAPACITANCE VS. TEST LEVEL (MEASURED AT 10 Mc)

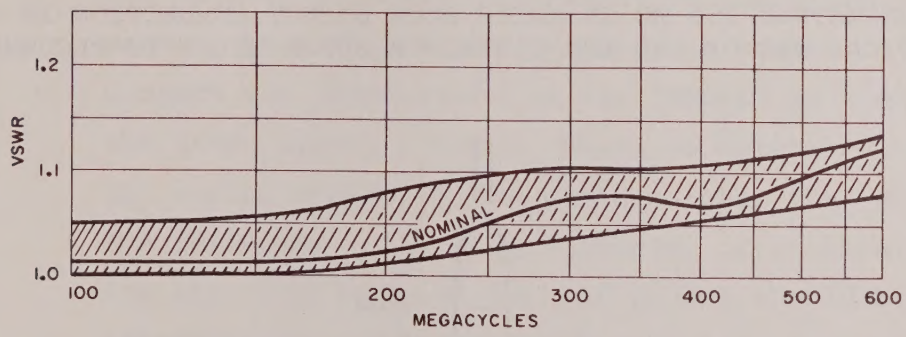


FIGURE 1C. TYPICAL VSWR OF 92-12 RF PROBE with 91-8 50Ω ADAPTER

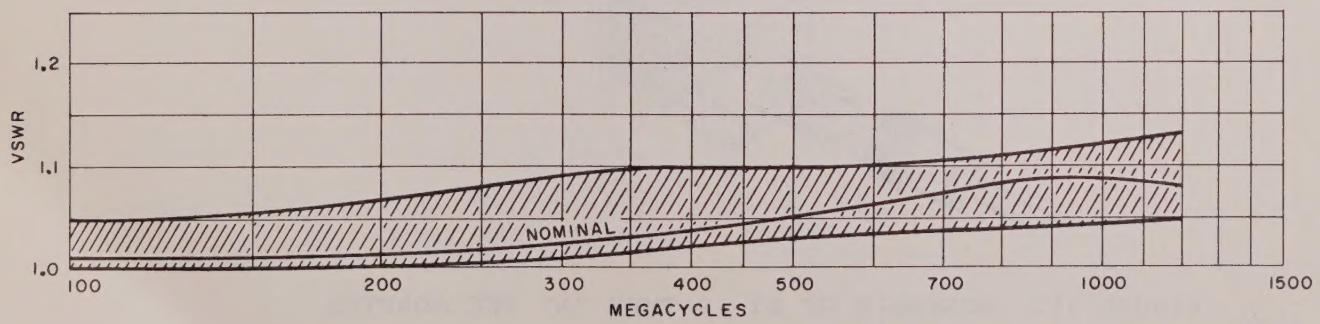


FIGURE 1D. TYPICAL VSWR OF 91-12 RF PROBE WITH 91-14 TYPE "N" TEE ADAPTER TERMINATED IN A 91-15 50Ω TERMINATION

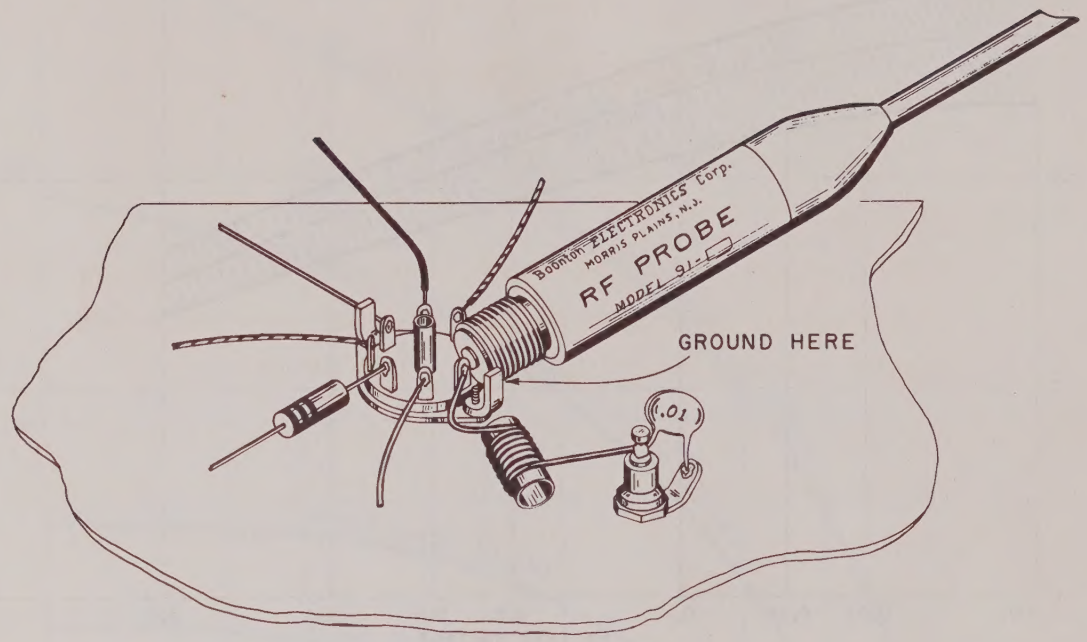


FIGURE 1E. METHOD FOR CONNECTING RF PROBE DIRECTLY TO TEST SIGNAL POINT WITH LOW CAPACITANCE GROUND. IN CASES ABOVE APPROXIMATELY 250 MC IN WHICH SUCH DIRECT CONNECTION IS NOT PRACTICAL USE OF THE TEE CONNECTOR SHOWN BELOW IS RECOMMENDED.

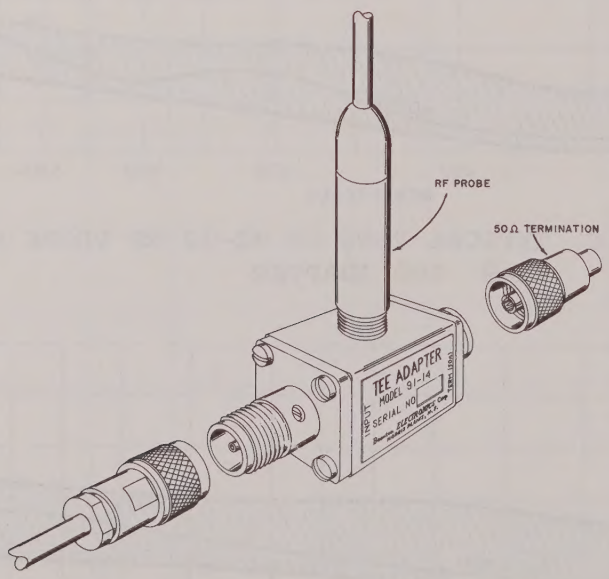


FIGURE 1F. ASSEMBLY OF 91-14 TYPE "N" TEE ADAPTER

SECTION III

OPERATING PROCEDURE

3.1 General

This section should be read carefully before using the instrument. It contains information necessary for proper operation of the Model 91CA RF Voltmeter.

3.2 The power line frequency and voltage requirements of the Model 91CA are indicated on the Serial Number name plate. It is important that the instrument be plugged into its proper power source.

3.3 Turn-on Procedure

a. With the power cord plugged into an appropriate a-c source, turn the instrument on and allow a warm-up period of approximately one minute.

b. Connect the probe cable to the "PROBE" jack on the front panel. (Note: Check to determine that the serial number of the probe matches that of the instrument. Each RF Voltmeter is calibrated for its individual probe. If probes should be interchanged without recalibrating the instrument, errors in measurement may result.)

d. Set RANGE-FULL SCALE control to .001 and carefully adjust "BAL" control for minimum meter deflection. Normal meter deflection for zero input signal shall then be as follows:

RANGE	DEFLECTION
.001	less than 3/4 inch
.003, .01, .03, .1, .3, 1	less than 1/16 inch
3	Suppressed

3.6 Measurement Procedure

a. Set RANGE-FULL SCALE control to appropriate setting (or higher) for voltage to be measured.

b. Connect probe ground clip to ground point of voltage source under test. This connection must be as short and direct as possible to minimize errors arising from circulating RF currents in the ground return impedance.

c. Connect probe tip to high point of voltage source under test. This connection must also be as short as possible to minimize resonance rise effects at frequencies above 100 megacycles.

d. Read RF voltage on appropriate meter scale corresponding to setting of RANGE-FULL SCALE CONTROL.

e. To obtain relative level readings in decibels add the DB (red scale) meter reading to the DB (red) setting of the RANGE-FULL SCALE control. Although individual DB readings have no significance as measured on the 91 type RF Voltmeter the difference between two DB readings represents the actual change in level on a decibel basis. When used with a good signal generator the DB scale greatly facilitates the measurement of relative attenuation and bandpass characteristics of networks.

f. As it is frequently desired to measure RF voltages in coaxial systems the Model 91 is provided with a 50Ω coaxial adapter having a low VSWR up to 600 MC.

3.7 Operating Precautions

3.8 Maximum Input Voltages

RF voltages exceeding 10 volts must not be applied to the probe or permanent damage to the crystal diodes may result. The 50Ω adapter should not be subjected to continuous overloads exceeding 10 volts to avoid excessive heating of terminating resistor.

Maximum DC voltage for RF probe is 300 volts.

Maximum DC voltage for 50Ω adapter is 10 volts.

Note: Do not apply maximum DC voltage simultaneously with maximum RF voltage when using 50Ω adapter

3.9 Temperature Effects

The normal ambient temperature range for specified accuracy is 65° to 90° F. Appreciable inaccuracies can be expected while the probe is exposed to temperatures above or below this range. No permanent change in probe characteristics will result from the high or low temperature exposure.

Inaccuracies due to temperature effects may occur after soldering to the probe tip or from heat sources such as resistors or tubes.

When making low level measurements in the order of 2 millivolts or less, it is important to make sure that the probe has attained a uniform temperature throughout. A temperature difference between the inside and outside of the probe can generate a small thermal voltage that may add to or subtract from the DC voltage generated by the diodes.

3.10 Hum, Noise, and Spurious Pick-up

When measuring low level RF voltages, precautions should always be taken to avoid the possibility of erroneous readings resulting from hum, noise, or stray RF pick-up. Although all low frequency hum and noise is attenuated at the input by 60 db, it is still possible for high level unwanted signals to get through and cause errors. The best test for this condition is to reduce the test signal to zero level and note whether the voltmeter continues to read some spurious signal level. In some cases it may be necessary to provide extra shielding around the probe connections to reduce stray field pick-up. Typical sources of spurious radiation are induction or dielectric heating units, diathermy machines, local radio transmitters, grid dip meters, and amplifiers with parasitic oscillatons.

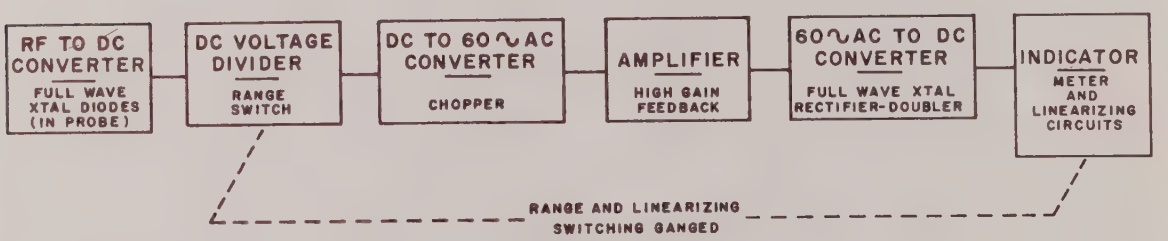


FIGURE 2. BLOCK DIAGRAM
MODEL 91 RF VOLTMETER

SECTION IV

THEORY OF OPERATION

An understanding of the operating features of the Model 91 Sensitive RF Voltmeter may be obtained by a study of the block diagram (Fig. 2) in conjunction with the following description.

The radio frequency voltage to be measured is rectified in the RF Probe by means of a full wave germanium diode rectifier circuit. The resulting DC potential is then attenuated as required before conversion to 60 ∿ AC by the chopper. This AC signal is then amplified in a narrow band feed-back stabilized amplifier prior to its re-conversion to DC for use in actuating the meter.

The germanium diodes used in the RF Probe have been carefully selected for several characteristics. As the selected diodes do not all exhibit the same rectification efficiency characteristics, it becomes necessary to adjust each meter range to match individual probe diodes. The range adjustments consist of individual non-linear circuits shunting the output meter circuitry. As the RANGE switch is set to the required test voltage position the appropriate non-linear adjusting circuit is automatically shunted across the output. It is also important to understand that the non-linear output circuitry is designed to compensate for the non-linear characteristics of the probe diodes when operating at levels below 0.3 volt.

SECTION V

MAINTENANCE

5.1 Periodic Checking

The Model 91CA Voltmeter is designed to give long periods of service without maintenance when operated in accordance with these instructions. It is recommended, however, that the instrument be checked occasionally using reliable standards to insure against errors resulting from deterioration of tubes or chopper. To make these checks, it is necessary to have a signal source in the 200 to 500 KC region with less than 2% distortion at levels up to 3 volts across 50Ω. A precision electronic voltmeter of the averaging response type, such as the Ballantine Model 310A or 314, Hewlett Packard Model 400D or 400H, may be used to monitor the signal source for this purpose. To insure its accuracy, the monitoring meter should be checked at some low frequency (50-100 ∿) of good waveform against a dynamometer type AC meter of at least 1% accuracy.

5.2 Calibration Precautions

When attempting to check the voltage calibration accuracy on an instrument having the sensitivity and bandwidth of the Model 91CA, it is essential to take precautions to avoid errors resulting from stray pick-up voltages. (See paragraph 3.10). A well shielded signal source must be used in conjunction with coaxial connections to both the Model 91CA and the standard reference meter. Even with a well shielded generator and associated connections, it is sometimes possible for the reference meter to pick up stray RF signals and feed them into the probe. Check for this condition by disconnecting standard meter and noting change in level.

5.3 Calibration Check Procedure

With suitable calibrating equipment (paragraph 5.1) and taking necessary precautions (paragraph 5.2), we can now check the Model 91CA for calibration accuracy. Each range should be checked at a voltage representing 90% of full scale value. If these check points agree within ± 2% of the standard, it is recommended that no adjustment be made. If the check points deviate by more than ± 5% from the standard, it is recommended that a trouble shooting procedure be followed as outlined in paragraph 5.4. If the check points fall between 2% and 5% of the standard, the calibration adjustment procedure as outlined in paragraph 5.5 should be followed.

5.4 Trouble Shooting Procedure

a. Case Removal

The instrument may be removed from its case after first removing the two screws located at the back of the case (near the bottom) and the four screws located on the sides of the case near the front.

The power supply may be removed from the case after first removing the four screws located on the sides of the case near the rear.

b. Tube Replacement

If the tube V1 should become weak or noisy, it should be replaced with BEC 525001 or a commercial low noise 12AX7 which has low microphonism and meets the requirements of paragraph 3.5d above. The Telefunken ECC83/12AX7 has been found to meet these requirements consistantly. After replacing defective tubes, re-check calibration as outlined in paragraph 5.3 and adjust if necessary as described in paragraph 5.5.

c. Chopper Replacement

If a satisfactory operation is not obtained by replacing

tubes, a replacement chopper should be tried. If the new chopper does not clear the difficulty, place the original chopper back in socket.The calibration accuracy must be re-checked and adjusted, if necessary.

d. Voltage and Resistance Tests

After determining that the trouble cannot be cured by replacement of tubes or chopper, as described previously,it is advisable to make a systematic check of AC voltage, DC voltage, and resistance at each socket pin. Table I shows the nominal AC and DC voltages to ground from each socket pin number. Table II shows the nominal resistance values expected for each point. Large or erratic deviations from the listed values of voltage or resistance will serve as a valuable clue in tracking down a faulty component. Once the trouble has been found and corrected, the calibration must be re-checked and re-adjusted as outlined in paragraph 5.3 and paragraph 5.5.

5.5 Calibration Adjustment Procedure

Before making any calibration adjustments, it is essential to provide the necessary reference standards as described in paragraph 5.1 and take all precautions as outlined in paragraph 5.2. The calibration adjustment procedure shall than be made as outlined in Table III.

TABLE I

VOLTAGE MEASUREMENTS

Conditions:

117V 60∿ line input.

VTVM used for all measurements.

All measurements to chassis unless otherwise noted.

Input .01V at any frequency between 100 KC and 1 MC.

Use Ballantine Model 314 VTVM for all AC voltage measurements.

Pin #		1	2	3	4	5	6	7	8	9	10	11
Tube	DC	70	0	.76	53	53	90	0	.85	47	-	-
V1 BEC 525001	AC	2.7mv	1.4mv				.1V	2.3mv			-	-
	DC	.69	1.7	59	53	30	38	1.7	-	-	-	-
V2 (6AU6)	AC	.1				.78						
	DC	300	100	50	0	0	1.35	.1	170	96	-	-
V3 (7199)	AC	.4	21		6.3	6.3			18	21	-	-
	DC							350				
V4 (6X4)	AC	340		6.3	6.3		340					
	DC	150				150						
V5 (0A2)	AC											
	DC					52		150	300	0	47	58
11 Pin socket	AC	6.2	6.2	115	115							
	DC											
Chopper Socket	AC			1.5 mv								
				DC 11								
Pin 10 to Pin 11 of 11 Pin Socket				AC .32								
				DC 5.4								
Pin 10 to Pin 5 of 11 Pin Socket				AC .015V								

TABLE II

RESISTANCE MEASUREMENTS

Conditions:

Power turned off.

Tubes in sockets, chassis interconnected (11 Pin), all measurements to chassis.

Pin # / Tube	1	2	3	4	5	6	7	8	9	10	11
V1 BEC 525001	1.2M	6.8M	11K	16K	16K	500K	2.2M	6.8K	16K	-	-
V2 (6AU6)	850K	3.8K	16K	16K	500K	1M	3.8K	-	-	-	-
V3 (7199)	68K	300K	1.1M			1.2K	1M	20K	1M	-	-
V4 (6X4)	300	-			-	300	68K	-	-	-	-
V5 (OA2)	50K	0	-	0	50K	-	0	-	-	-	-
11 Pin Conn.	-	-	∞	∞	17K	-	45K	60K	0	16K	16K

TABLE III

CALIBRATION ADJUSTMENT PROCEDURE

Step	Reference Std. Voltage	Voltage Range Setting Model 91CA	Adjust #	Adjust To Read	Notes
1.	.3	1	1	.3	Main gain adjustment: affects down scale readings on ranges 3 v to .1 v.
2.	.9	1	2	.9	Slope adjustment: affects up scale readings more than down scale: adjusts 1 v range only.
3.	2.5	3	3.	2.5	Slope adjustment: affects up scale readings more than down scale: adjusts 3 v range only.
4.	.25	.3	4.	.25	Slope adjustment: affects up scale readings more than down scale: adjusts .3 v range only.
5.	.09	.1	5	.09	Slope adjustment: affects up scale readings more than down scale: adjusts .1 v range only.
6.	.003	.01	6.	.003	Main gain adjustment: affects down scale readings on ranges .03 v to .003v.
7.	.005	.01	7	.005	Mid range slope adjustment: affects mid scale linearity on .01 v range only.
8.	.009	.01	8	.009	Slope adjustment: affects up scale readings more than down scale: .01 v range only.
9.	.025	.03	9	.025	Slope adjustment: affects up scale reading more than down scale: adjusts .03v range only.
10.	.0025	.003	10	.0025	Slope adjustment: affects up scale reading more than down scale: adjusts .003 range only.
11.	.0009	.001	11	.0009	Main gain adjustment: adjusts calibration of .001 v range only.

NOTE: Adjustment #1 to 6 are located from front to rear on right side of cabinet.
Adjustment #7 to 11 are located from rear to front on left side of cabinet.

WARRANTY

Boonton ELECTRONICS Corporation guarantees to the original purchaser that each instrument it manufactures is free from defects in material and workmanship for a period of one year after date of initial shipment. Our liability is limited to repairing or replacing any defective part with the exception of vacuum tubes, panel lamps, fuses, and batteries. The warranty lapses if, upon our examination, we judge that the instrument has been abused in any way.

PROCEDURE TO FOLLOW WHEN INSTRUMENT IS DEFECTIVE

1. Call our plant or our representative nearest you. A simple solution may result from discussion of the problem with our trained personnel.
2. If the fault is not readily eliminated, prepare the instrument for return to us. Pack carefully in a sturdy container using several inches of shock absorbing material on all six sides of the instrument. Include all probes, cables or accessory units. On all paper work pertaining to the returned instrument, note the model and serial number and state briefly the details of the fault. Ship to us transportation charges prepaid.
3. If the instrument is within the warranty, we will repair and return to you transportation charges prepaid. If the instrument is beyond the one year warranty period, we will repair and return it unless approval on a cost estimate is requested. If the instrument is within the one year warranty period, but our examination reveals abuse, we will await approval of our cost estimate before proceeding with repairs.

PARTS LIST 91CA

Reference		Description			BEC Part No.
C1	Capacitor, Mylar	0.1	µf	200V	230,116
C2	" Mylar	0.1	µf	200V	230,116
C3	" Mylar	0.1	µf	200V	230,116
C4	" Mylar	0.1	µf	200V	230,116
C5	" Mylar	0.0033	µf	200V	230,119
C6	" Mylar	0.022	µf	200V	230,101
C7a	" Elect.	20	µf	450V	283,139
C7b	" Elect.	50	µf	250V	
C8	" Mylar	0.005	µf	200V	230,121
C9	" Elect.	50	µf	6V	283,145
C10	" Elect.	50	µf	6V	283,145
C11	" Mylar	0.1	µf	200V	230,116
C12	" Mylar	0.022	µf	200V	230,101
C13	" Mylar	0.1	µf	200V	230,116
C14	" Mylar	0.1	µf	200V	230,116
C15	" Mylar	0.047	µf ±5%	200V	234,026
C16	" Mylar	0.002	µf ±5%	200V	234,024
C17	" Elect.	50	µf	6V	283,145
C18	" Mylar	0.033	µf ±5%	200V	234,025
C19	" Mylar	0.033	µf ±5%	200V	234,025
C20	" Mylar	0.022	µf	200V	230,101
C21	" Mylar	0.1	µf	200V	230,116
C22	" Mylar	0.1	µf	200V	230,116
C23	" Met. Paper	1.0	µf	200V	230,104
C24	" Elect.	50	µf	6V	283,145
C25	" Elect.	5	µf	50V	283,143
C27a,b,c	" Elect.	20-20-20	µf	450V	283,113
C28a,b	" Elect.	1000-1000	µf	15V	283,114
C29	" Disc.	0.05	µf	100V	224,117
C30	" Elect.	50	µf	6V	283,145
C31	" Mylar	0.1	µf	200V	230,116

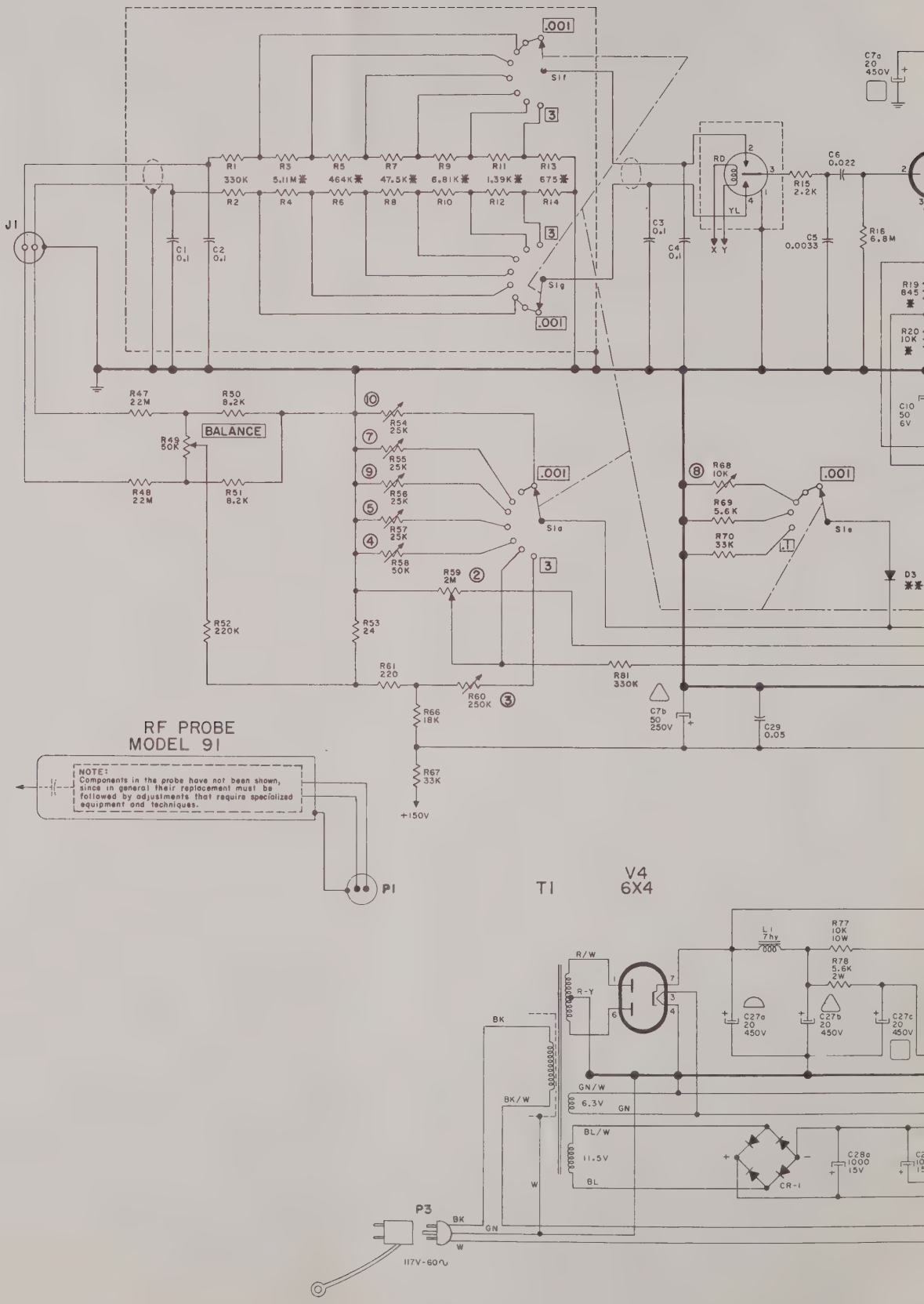
Reference	Description	BEC Part No.
CH-1	Chopper, BBM-Special	540,108
	Alternate Chopper	540,113
CR-1	Rectifier, Sel. Sarkes-Tarzian #304B	532,001
D1	Diode 1N600	530,008
D2	Diode 1N600	530,008
D3	Diode	530,040
D4	Diode	530,040
F1	Fuse MDL 0.5 Amp	545,504
I1	Lamp #47	545,101
I2	Lamp #47	545,101
J1	Receptacle Amphenol 80-PC-2FT	479,119
J2	Socket Amphenol 77-MIP-11	472,101
L1	Choke Stancor #C1707 7HY	440,001
M1	Meter Special 0-200 μa	554,139
P1	Plug (Input Cable) Amphenol 80-MC-2M	479,101
P2	Plug (Amplifier) Amphenol 86-PM11-11	477,105
P3	Plug & AC Line Cord	568,101
R1	Resistor, Comp. 330K 1/2W 5%	301,147
R2	" 330K 1/2W 5%	301,147
R3	" Dep.Car. 5.11Meg. 1/2W 1%	306,788
R4	" " " 5.11Meg. 1/2W 1%	306,788
R5	" " " 464K 1/2W 1%	306,558
	Adapter, grounding	771,006

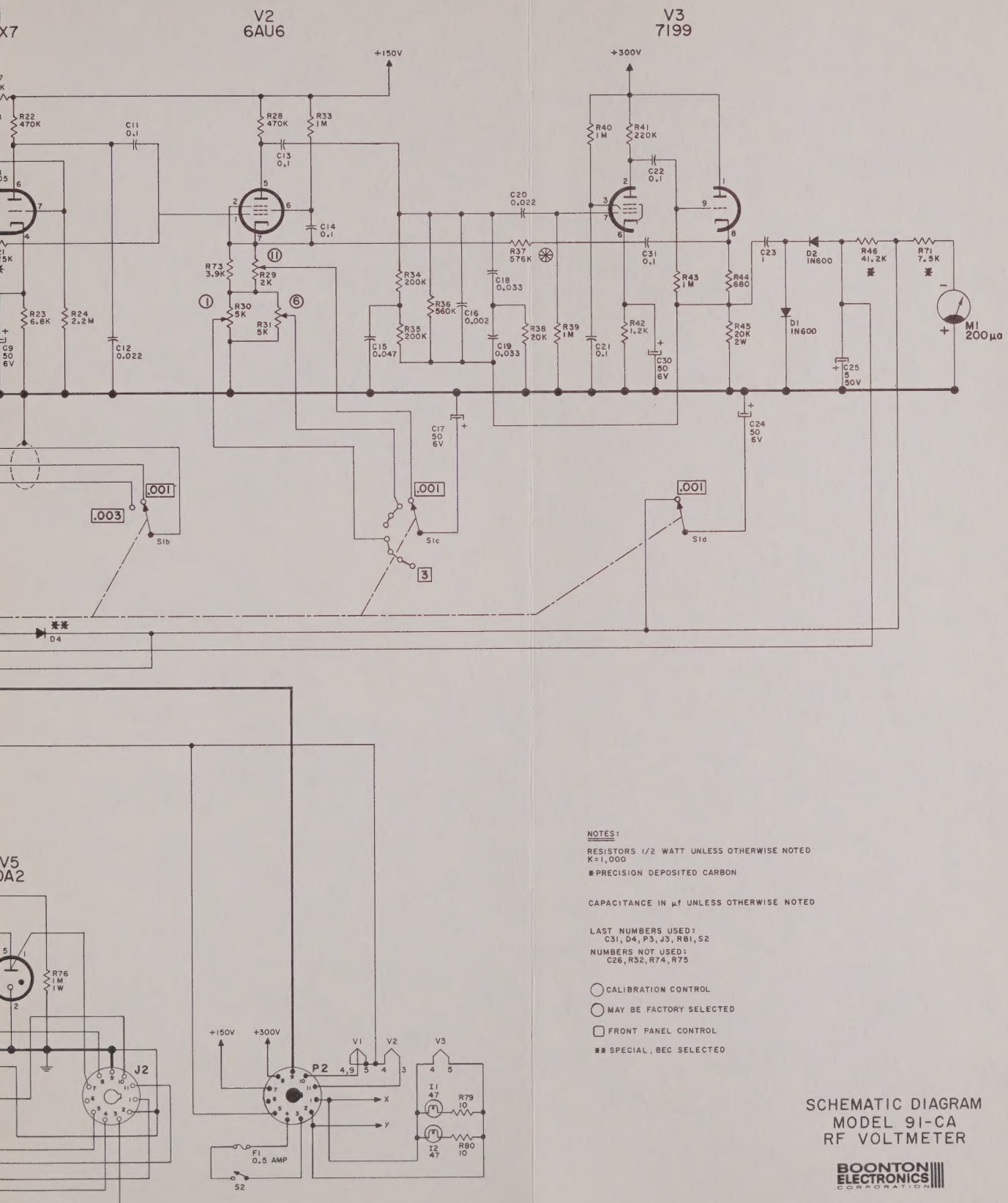
Reference		Description				BEC Part No.
R6	Resistor, Dep.Car.	464K	1/2W	1%		306,558
R7	" " "	47.5K	1/2W	1%		306,440
R8	" " "	47.5K	1/2W	1%		306,440
R9	" " "	6.81K	1/2W	1%		306,339
R10	" " "	6.81K	1/2W	1%		306,339
R11	" " "	1.39K	1/2W	1%		306,694
R12	" " "	1.39K	1/2W	1%		306,694
R13	" " "	675Ω	1/2W	1%		306,695
R14	" " "	675Ω	1/2W	1%		306,695
R15	" " "	2.2K	1/2W	5%		301,095
R16	" Comp.	6.8 Meg.	1/2W	5%		301,179
R17	" "	47K	1/2W	5%		301,127
R18	" "	1 Meg.	1/2W	5%		301,159
R19	" Dep. Car.	845Ω	1/2W	1%		306,231
R20	" " "	10K	1/2W	1%		306,359
R21	" " "	825K	1/2W	1%		306,589
R22	" Comp.	470K	1/2W	5%		301,151
R23	" "	6.8K	1/2W	5%		301,107
R24	" "	2.2 Meg.	1/2W	5%		301,167
R28	" "	470K	1/2W	5%		301,151
R29	" Variable	2K	2W	10%	(11) ADJ	311,126
R30	" "	5K	2W	20%	(1) ADJ	311,101
R31	" "	5K	2W	20%	(6) ADJ	311,101
R33	" Comp.	1 Meg.	1/2W	5%		301,159
R34	" "	200K	1/2W	5%		301,142
R35	" "	200K	1/2W	5%		301,142
R36	" "	560K	1/2W	5%		301,153

Reference		Description				BEC Part No.
R37	Resistor, Dep. Car.	1Meg.	1/2W	1%		306,570
R38	" Comp.	20K	1/2W	5%		301,118
R39	" "	1M	1/2W	5%		301,159
R40	" "	1M	1/2W	5%		301,159
R41	" "	220K	1/2W	5%		301,143
R42	" "	1.2K	1/2W	5%		301,089
R43	" "	1Meg.	1/2W	5%		301,159
R44	" "	680Ω	1/2W	5%		301,083
R45	" "	20K	2W	5%		304,118
R46	" Dep. Car.	41.2K	1/2W	1%		306,432
R47	" Comp.	22Meg.	1/2W	5%		301,191
R48	" "	22Meg.	1/2W	5%		301,191
R49	" Variable	50K	2W	20%	Bal	311,125
R50	" Comp.	8.2K	1/2W	5%		301,109
R51	" "	8.2K	1/2W	5%		301,109
R52.	" "	220K	1/2W	5%		301,143
R53	" "	24Ω	1/2W	5%		301,048
R54	" Variable	25K	2W	20%	(10) Adj	311,115
R55	" "	25K	2W	20%	(7) Adj	311,115
R56	" "	25K	2W	20%	(9) Adj	311,115
R57	" "	25K	2W	20%	(5) Adj	311,115
R58	" "	50K	2W	20%	(4) Adj	311,163
R59	" "	2Meg	2W	20%	(2) Adj	311,195
R60	" "	250K	2W	20%	(3) Adj	311,103
R61	" Comp.	220Ω	1/2W	5%		301,071
R66	" "	18K	1/2W	5%		301,117
R67	" "	33K	1/2W	5%		301,123
R68	" Variable	10K	2W	20%	(8) Adj	311,102

Reference		Description	BEC Part No.
R69	Resistor, Comp.	5.6K 1/2W 5%	301,105
R70	" "	33K 1/2W 5%	301,123
R71	" Dep. Car	7.5K 1/2W 1%	306,344
R73	" Met. Film	3.9K 1/2W 5%	315,002
R76	" Comp.	1 Meg. 1W 20%	302,128
R77	" W.W.	10K 10W 10%	312,103
R78	" Comp.	5.6K 2W 5%	304,105
R79	" "	10 Ω 1/2W 5%	301,039
R80	" "	10 Ω 1/2W 5%	301,039
R81	" "	330K 1/2W 5%	301,147
S1	Switch 7 pole 8 pos.	spec. (91CA)	466,145
S2	" SPST. Carling #110-63		465,105
T1	Transformer	Power, special	446,016
V1	Elect. Tube	12AX7, special	525,001
V2	Elect. Tube	6AU6	526,6AU6
V3	Elect. Tube	7199	526,7199
V4	Elect. Tube	6X4	526,6X4
V5	Elect. Tube	0A2	526,0A2

CH-1


.001
S1f
3
R1 330K
R3 5.11M
R5 464K
R7 47.5K
R9 6.81K
R11 1.39K
R13 675
R2
R4
R6
R8
R10
R12
R14
J1
C1 0.1
C2 0.1
C3 0.1
C4 0.1
RD
YL
X Y
C7a 20 450V
C6 0.022
R15 2.2K
C5 0.0033
R16 6.8M
S1g
R47 22M
R50 8.2K
BALANCE
R49 50K
R48 22M
R51 8.2K
R52 220K
R53 24
R54 25K
R55 25K
R56 25K
R57 25K
R58 50K
R59 2M
R61 220
R60 250K
R66 18K
R67 33K
+150V
S1a
R68 10K
R69 5.6K
R70 33K
.1
S1e
D3
R81 330K
C7b 50 250V
C29 0.05
RF PROBE
MODEL 91
NOTE:
Components in the probe have not been shown, since in general their replacement must be followed by adjustments that require specialized equipment and techniques.
P1
T1
V4
6X4
L1 7hy
R77 10K 10W
R78 5.6K 2W
C27a 20 450V
C27b 20 450V
C27c 20 450V
R/W
R-Y
BK
GN/W
6.3V
GN
BK/W
BL/W
11.5V
BL
W
CR-1
C28a 1000 15V
P3
BK
GN
W
117V-60~



NOTES:

RESISTORS 1/2 WATT UNLESS OTHERWISE NOTED
K=1,000

*PRECISION DEPOSITED CARBON

CAPACITANCE IN μf UNLESS OTHERWISE NOTED

LAST NUMBERS USED:
C31, D4, P3, J3, R81, S2

NUMBERS NOT USED:
C26, R32, R74, R75

◯ CALIBRATION CONTROL

◯ MAY BE FACTORY SELECTED

▢ FRONT PANEL CONTROL

** SPECIAL, BEC SELECTED

SCHEMATIC DIAGRAM
MODEL 91-CA
RF VOLTMETER

BOONTON ELECTRONICS CORPORATION

830,083K

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